Tujunga Wellfield Site Discovery
Draft Stage III Report
Los Angeles County, California

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Prepared by:
Weston Solutions, Inc.

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List of Acronyms

AOC	Analyte of Concern
bgs	below ground surface
BSB	Branford Spreading Basin
CDHS	State of California Department of Health Services
CDPH	State of California Department of Public Health
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
CLPAS	Contract Laboratory Program Analytical Services
CRQL	CLP Contract Required Quantitation Limits
DQO	Data Quality Objective
DQI	Data Quality Indicator
DPW	Los Angeles County Department of Public Works
DTSC	Department of Toxic Substances Control
ECL	Environmental Chemistry Laboratory (State of California DTSC Lab)
EPA	United States Environmental Protection Agency
HRS	Hazard Ranking System
IDW	Investigation-Derived Wastes
LADWP	Los Angeles County Department of Water and Power
LARWQCB	State of California Los Angeles Regional Water Quality Control Board
MCL	Maximum Contaminant Level
mg/kg	Milligrams per kilogram
mg/L	Milligrams per Liter
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NPL	National Priority List
PCE	tetrachloroethene
PM	Project Manager
ppb	parts per billion
QA	Quality Assurance
QAO	Quality Assurance Office
QC	Quality Control
SAM	Site Assessment Manager
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act of 1986
SOP	Standard Operating Procedure
TCE	Trichloroethene
ug/kg	Micrograms per kilogram
ULARA	Upper Los Angeles River Authority
VOC	Volatile Organic Compound
VFZ	Verdugo Fault Zone

1.0 INTRODUCTION

Under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA), Weston Solutions, Inc. (WESTON®) has been tasked to conduct a Hazard Ranking System (HRS) Discovery Project in the matter of groundwater contamination identified in the Tujunga Well Field located in Los Angeles County, California. The HRS assesses the relative threat associated with actual or potential releases of hazardous substances to the environment, and has been adopted by the U. S. Environmental Protection Agency (EPA) to assist in setting priorities for further site evaluation and potential remedial action. The HRS is the primary method for determining a site's eligibility for placement on the National Priorities List (NPL). The NPL identifies sites where the EPA may conduct remedial actions.

This Tujunga Wellfield Report covers activities included in three stages of EPA Site Assessment activity conducted as part of a broader multi-agency investigation. Stage I involves EPA-directed soil gas and soil sampling conducted in coordination with a State of California, Department of Toxic Substances Control- (DTSC-) lead Site Discovery, and a City of Los Angeles, Department of Water and Power- (LADWP-) lead groundwater sampling program. Stage II consists of a coordinated effort to repair/refurbish two key monitoring wells in the study area, as well as sediment sampling in the nearby Branford Spreading Basin (BSB). Stage III consists of planning for new monitoring wells, which will be installed at a later date.

1.1 Statement of the Specific Problem

The Tujunga Well Field (see Figure 1-1) is a series of twelve groundwater production wells installed in the Tujunga Spreading Basin, located near the intersection of the 170 and I-5 freeways in the eastern San Fernando Valley, Los Angeles County, California. The LADWP installed the wells in the early 1990s to offset production lost as a result of contamination at the North Hollywood and Burbank wellfields associated with the San Fernando Valley Superfund Sites, which lie down-gradient of the Tujunga Wellfield. Chlorinated volatile organic compounds (VOCs) have been detected in several of the Tujunga groundwater production wells at concentrations exceeding the Maximum Contaminant Limits (MCLs) during several quarterly sampling events over the last two decades. The LADWP has temporarily shut down several of the wells, and may have to permanently close these wells.

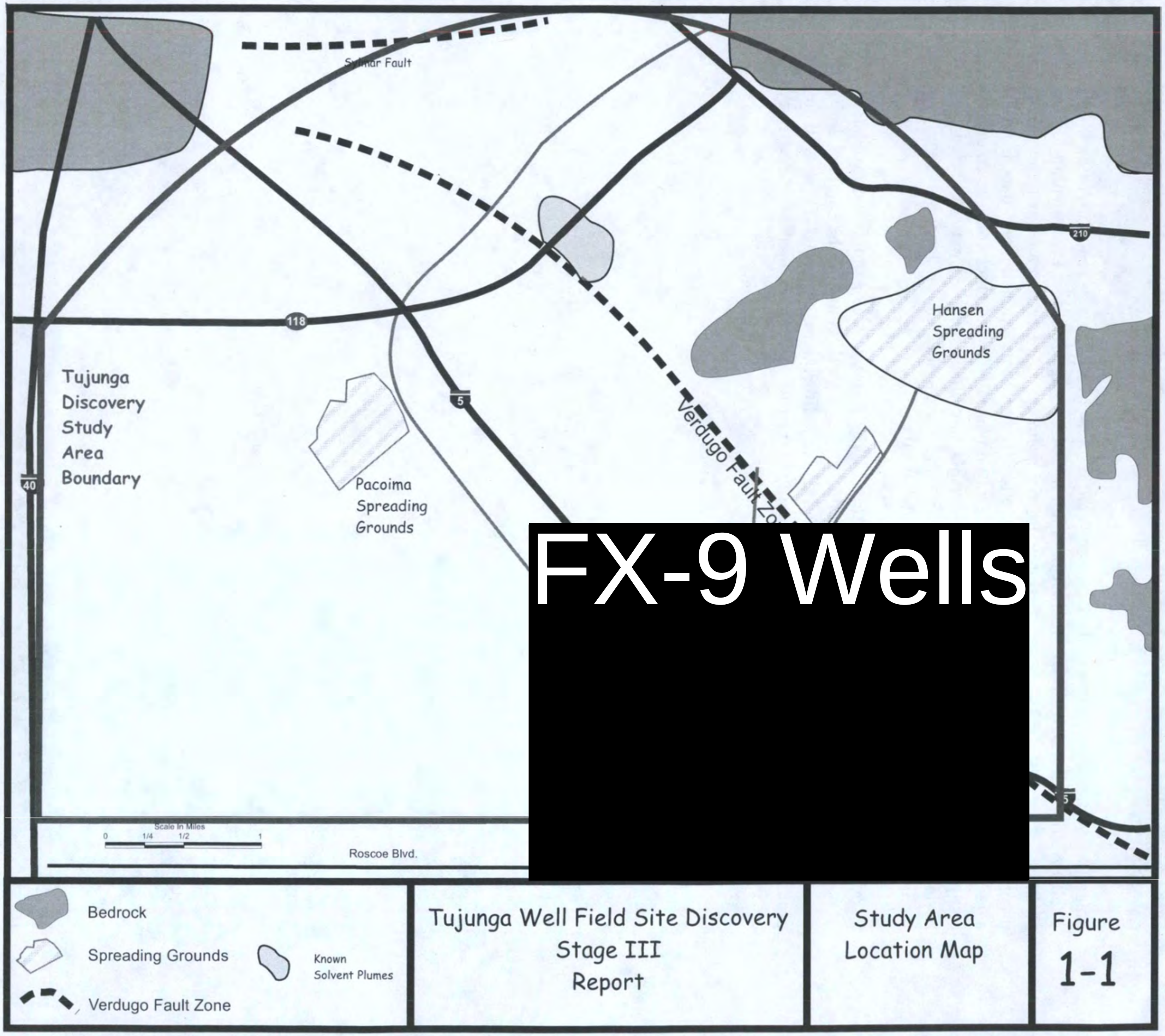
1.2 Investigation Approach

In early 2009, EPA conducted Stage I of this investigation, which included soil vapor and limited soil sampling along several miles of transects in the Study Area, as well as potential source facilities close to the site. The transect soil vapor results indicate three areas of concern along the transects where tetrachloroethene (PCE) and, to a lesser degree, trichloroethene (TCE) are detected. The site-specific soil vapor results indicate low levels of PCE at five of the six sites investigated. Details of the Stage I investigation are described in the Tujunga Wellfield

Discovery Stage I Report (Weston 2009), as well as the DTSC Tujunga Site Discovery Report (DTSC 2009).

Stage II activities are detailed in the Tujunga Wellfield Discovery Stage II report (Weston 2010). The EPA conducted Stage II of this investigation in 2010. Stage II of this investigation focuses on the adjacent BSB, which is the terminus for the drainage of a large area of historic activity involving auto dismantling, engine rebuilding, and electroplating. Contaminant data from the adjacent well field indicate a cluster of high concentrations of TCE and other chlorinated organic compounds in the wells directly adjacent to the BSB. Sediment samples were collected from borings through the BSB sediment pile, and samples were collected for laboratory analyses, including volatile organic compounds (VOCs) and metals.

In addition to sampling at the BSB, two existing LADWP groundwater monitoring wells, TJ-MW-01 and TJ-MW-03, were repaired and sampled. These wells could not be sampled during the 2008 LADWP groundwater monitoring event due to malfunctioning pumps. These well data provided critical data which can be used to determine, or rule out contaminant migration in the area near the Tujunga Wellfield.



Tujunga Well Field Site Discovery
Stage III
Report

Study Area
Location Map

Figure
1-1

2.0 BACKGROUND

2.1 Location and Description

The Tujunga Wellfield Site Discovery Study Area (Study Area) is located in the northeastern part of the San Fernando Valley, Los Angeles County California, and includes portions of the cities of San Fernando, Sun Valley, Pacoima, and unincorporated portions of the County of Los Angeles. The Study Area is defined as all portions of the San Fernando Groundwater Basin north of Roscoe Blvd. and east of I-405. The Study Area consists of residential, commercial, and industrial zoning covering an area of approximately 28 square miles. The location of the Study Area is shown in Figure 1-1.

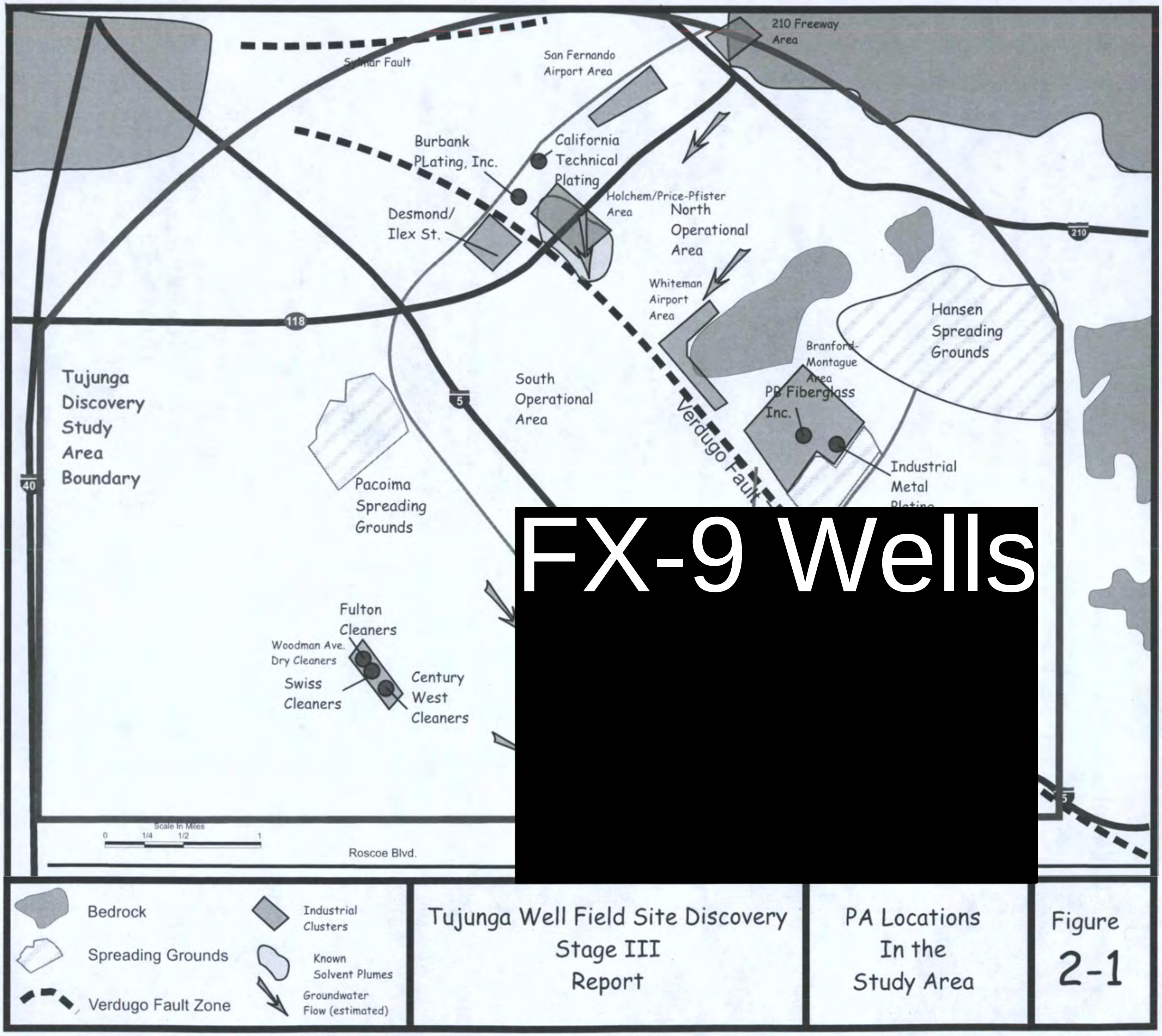
The Tujunga Well Field is located southwest of the intersection of the I-5 and 170 freeways. The well field consists of an array of twelve groundwater production wells; water from these wells is primarily used for drinking water throughout Los Angeles County. Groundwater generally flows from the northwest to the southeast, so the capture zone for the well field is predominantly to the north and northwest of the site. Groundwater flows from the northwest to the well field from the easternmost regions of the basin, including the Tujunga Canyon and minor drainages in the Verdugo Mountains (ULARA, 1981). Groundwater flow is complicated by the Verdugo Fault Zone (VFZ), which divides the site into North and South Operational Units (see Figure 1-1 and Section 2.4 below). Groundwater is recharged by DWP at several spreading grounds located across the study area; the spreading basins are associated with gravel deposits from the paleo-Tujunga and Pacoima washes.

2.2 Operational History

The twelve production wells of the Tujunga Wellfield were constructed between May 1988 and October 1991 by the LADWP. Each well is constructed with a 20-inch steel casing with a total depth of 800 feet below ground surface. The wells are screened at various intervals from 400 to 800 feet bgs (DWR, 2008). Each well is capable of producing water at rates exceeding 4,000 gallons per minute.

The LADWP operates 78 active drinking water wells that serve a population of approximately 3,850,000. The LADWP obtains 15 percent of its drinking water from groundwater. The remaining 85 percent is treated surface water purchased from the Metropolitan Water District (MWD) (LADWP, 2010).

The LADWP first detected chlorinated volatile organic compounds (VOCs) in Tujunga Wells at concentrations exceeding Maximum Contaminant Limits in March of 1993 (MCLs; see Historical VOC Data from CH2M Hill, 2009, in Appendix A). The LADWP began closing wells in the Tujunga Well Field beginning in April 2002. Currently, LADWP reports that nine wells are out of service due to VOC contamination (DWP, 2008).



210 Freeway Area
Sylmar Fault
San Fernando Airport Area
Burbank PLating, Inc.
California Technical Plating
Holchem/Price-Pfister Area
Desmond/ Ilex St.
North Operational Area
Whiteman Airport Area
Hansen Spreading Grounds
210
118
Branford-Montague Area
PB Fiberglass Inc.
Tujunga Discovery Study Area Boundary
South Operational Area
5
Verdugo Fault
Industrial Metal Plating
40
Pacoima Spreading Grounds
FX-9 Wells
[redacted]
Fulton Cleaners
Woodman Ave. Dry Cleaners
Swiss Cleaners
Century West Cleaners
Scale In Miles
0 1/4 1/2 1
Roscoe Blvd.
Bedrock
Spreading Grounds
Verdugo Fault Zone
Industrial Clusters
Known Solvent Plumes
Groundwater Flow (estimated)
Tujunga Well Field Site Discovery Stage III Report
PA Locations In the Study Area
Figure 2-1

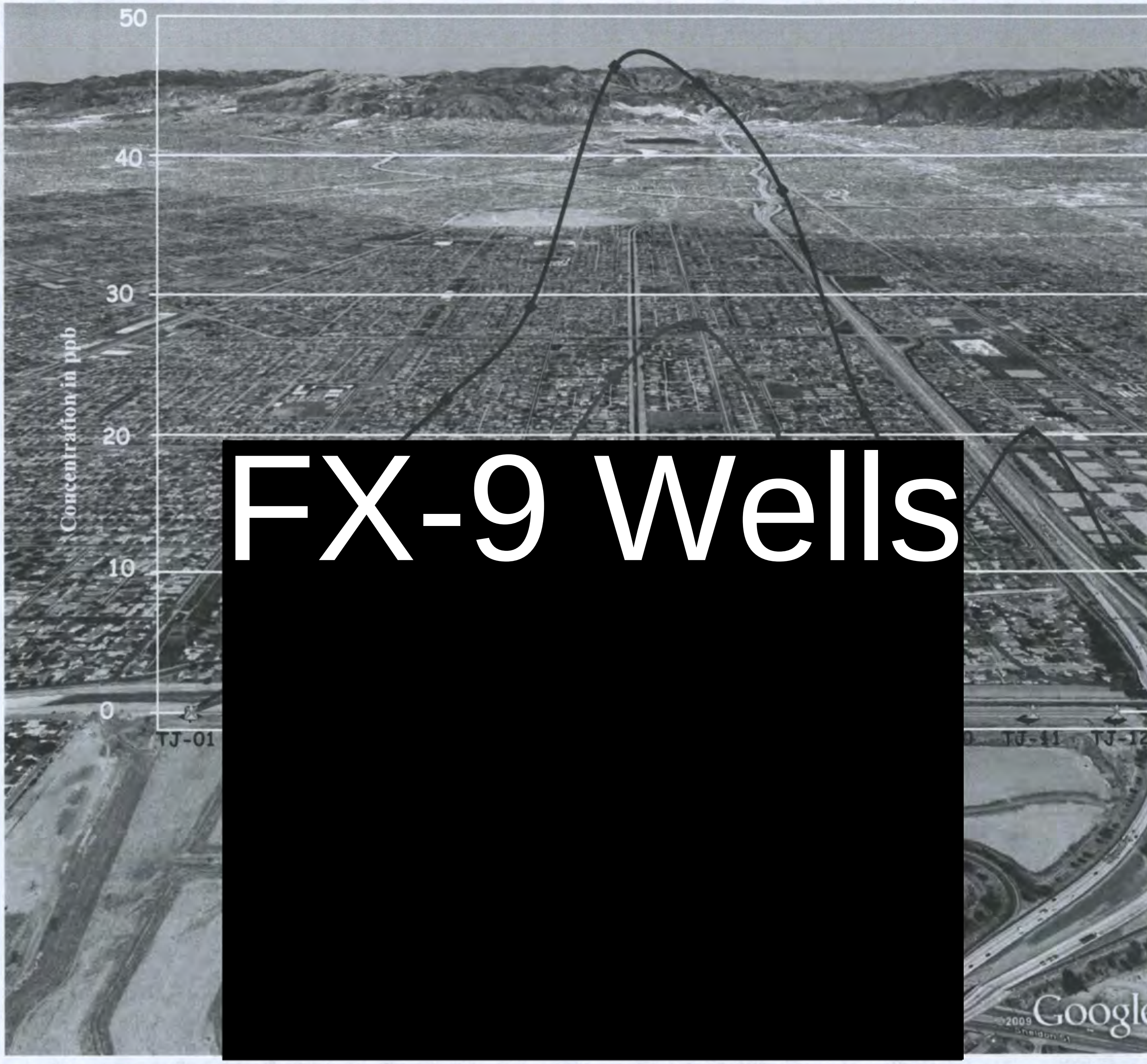


Figure 2-2: Chlorinated Volatile Organic Compounds in the Tujunga Well Field - Highest Concentrations 2000 - 2008

- TCE
- PCE
- Carbon Tetrachloride
- 1,2-Dichloro-ethene-cis

View is looking into the direction of groundwater flow

WESTON SOLUTIONS

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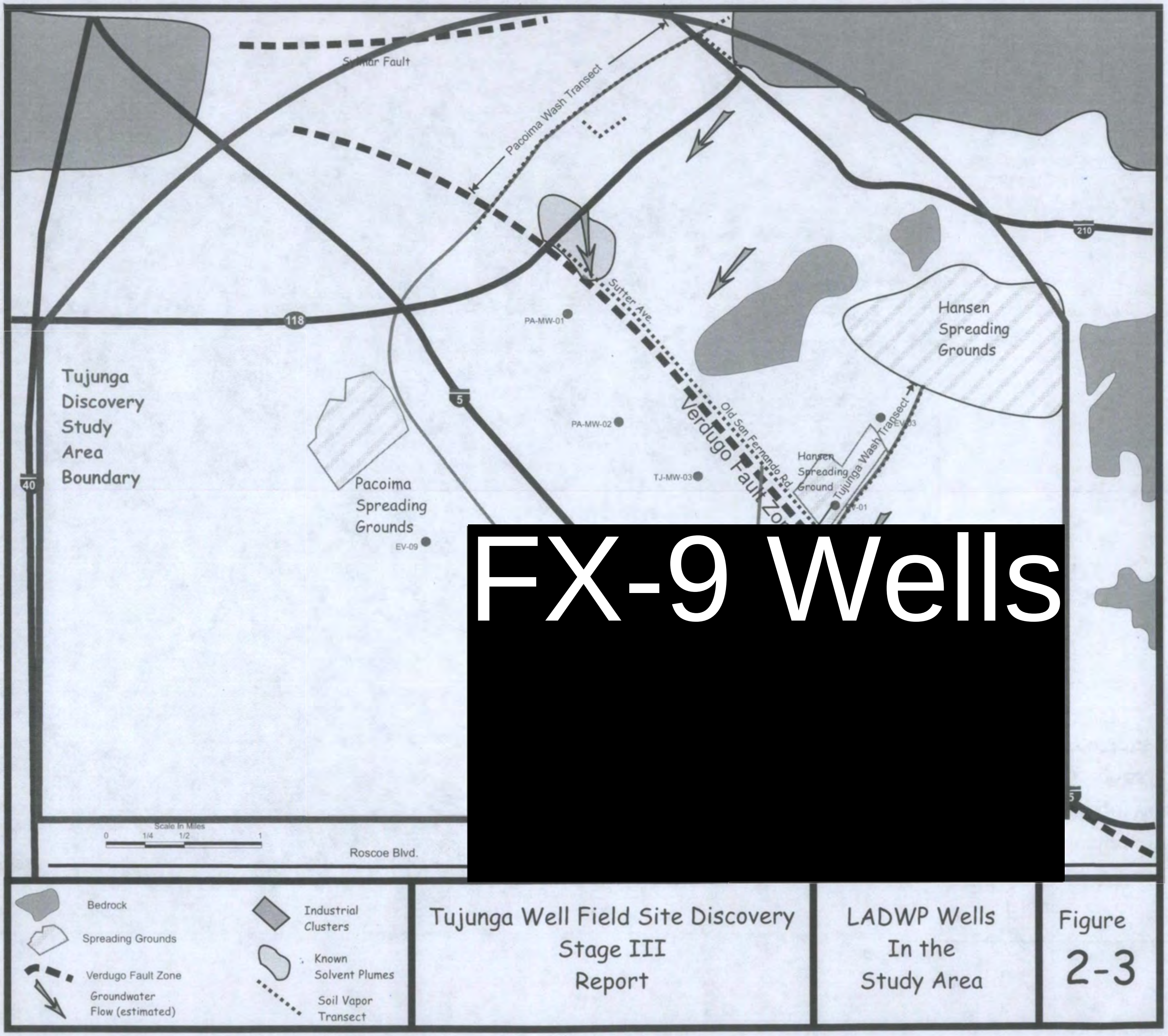
Data Sources
Map - GoogleEarth Pro 2009
VOC data from LADWP 2008



Tujunga Well Field Site Discovery Stage III Report

LADWP Wells In the Study Area

Figure 2-3

The LADWP installed three monitoring wells in order to determine the direction of potential sources of the contamination. Three wells constructed around the Tujunga Wellfield have "TJ-MW-" prefixes:

- TJ-MW-01 – Installed in a portion of the Tujunga Spreading Ground that lies to the southeast of the Wellfield. The well is placed in what is likely the cone of depression of the Wellfield, on the downgradient side, to monitor for contaminants migrating from the Sheldon-Arleta Landfill. This well was installed in 1996 and had not been sampled in ten years due to a faulty pump. LADWP was unable to sample this well during the 2008 sampling event; the Tujunga Workgroup refurbished this well and collected stratified groundwater samples from the well in December 2009. Results indicate no chlorinated AOCs above method detection limits in groundwater at this location.

- TJ-MW-02 – This well is located approximately one mile northwest of the Tujunga Wellfield. This well was sampled for AOCs during the 2008 LADWP sampling event. AOCs were not detected above the method detection limits.

- TJ-MW-03 – This well was installed in 2005 but never sampled due to a faulty pump. The Tujunga Workgroup refurbished this well and collected groundwater samples from the well in February 2010. Results indicate no chlorinated AOCs above method detection limits in groundwater at this location.

- TJ-MW-04 - This well is also known as "EV-08" (see below for a description of the East Valley series of monitoring wells), and it is located approximately one mile to the north of the Tujunga Wellfield. This well was sampled for AOCs during the 2008 LADWP sampling event. TCE and PCE are reported at 0.64 ppb and 0.60 ppb in groundwater at this location.

The LADWP also installed two wells between the Price-Pfister and Holchem facilities in 1997 to determine whether contaminants were migrating from those sites. These wells are:

- FX-9 Wells [redacted] This well was sampled for AOCs during the 2008 LADWP sampling event. TCE and PCE are reported at 1.1 ppb and 2.0 ppb in groundwater at this location.

- FX-9 Wells [redacted] This well was sampled for AOCs during the 2008 LADWP sampling event. Results indicate no chlorinated AOCs above method detection limits in groundwater at this location.

- An additional well was attempted to the southeast of the Whiteman Airport, but did not encounter groundwater. This may suggest that there is no groundwater beneath this area of the basin. This may be a result of the presence of exceptionally shallow crystalline bedrock and/or complex faulting structures in this area.

The LADWP also owns a series of monitoring wells that were installed in anticipation of the East Valley Water Reclamation Project, which was an aborted plan to spread tertiary-treated wastewater at the Hanson Spreading Basin, which is approximately 2 miles east-northeast of the Wellfield. The "EV-" wells were placed strategically to monitor the incursion of any possible contaminants in the groundwater pathway between the spreading ground and downgradient drinking-water wells.

- EV-01 – This well is located approximately 1.5 miles to the northeast of the Wellfield, in the Hanson Spreading Grounds. This well was not sampled during the 2008 LADWP sampling event due to construction activities occurring at that time. The well is not considered a high priority because data from wells directly downgradient (EVs -05b and -06b) indicate no AOCs above the method detection limit.

- EV-02 – This well is located approximately 1.25 miles to the northeast of the Wellfield, along the southern levy of the Hanson Spreading Grounds. This well was not sampled during the 2008 LADWP sampling event due to construction activities occurring at that time. The well is considered a medium priority because data from wells directly downgradient (EVs -05b and -06b) indicate no AOCs above the method detection limit.

- EV-03 – FX-9 Wells [redacted]. This well was sampled for AOCs during the 2008 LADWP sampling event. AOCs were not detected above the method detection limits.

- EV-04 - FX-9 Wells [redacted]. This well was not sampled during the 2008 LADWP sampling event due to an obstruction in the casing. This well location is considered a medium priority because data from wells directly downgradient (EVs -05b and -06b) indicate no AOCs above the method detection limit.

- FX-9 Wells [redacted]. This well was sampled for AOCs during the 2008 LADWP sampling event. AOCs were not detected above the method detection limits.

- FX-9 Wells [redacted]. This well was sampled for AOCs during the 2008 LADWP sampling event. AOCs were not detected above the method detection limits.

- EV-07 - This well is located approximately one mile to the east-northeast of the Wellfield, on Wick Street. This well was not sampled during the 2008 LADWP sampling event due to its cross-gradient location.

- EV-08 – This well is also known as TJ-MW-04. TCE and PCE are detected in this well; see above for data discussion.

- EV-09 - FX-9 Wells [redacted] This well was not sampled during the 2008 LADWP sampling event due to unknown sampling issues at the time of the sampling event. This well location is a medium to low priority because data from TJ-MW-02, a well located one mile downgradient of this well, indicate no AOCs above method detection limits.

2.3.3.2 Wellhead Purification Program

In an effort to continue utilizing groundwater from the Tujunga Wellfield for drinking water purposes, the LADWP is planning to construct a Wellhead Purification Complex. According to the policy of the CDPH, Policy Memorandum 97-005, an Evaluation Process for the use of Extremely Impaired Sources CDHS, 1997), an aquifer source characterization is required as part of the engineering permitting of the Wellhead Purification Complex, including the installation of groundwater monitoring wells for the characterization of the aquifer. New groundwater monitoring wells are therefore required to provide characterization data for the Tujunga Wellfield capture area, as well as provide sentinel data for incoming contamination to the wellfield for at least a ten-year lag time. A more detailed description of the scope of this project are presented in Section 5.0 below and in the Tujunga Discovery Stage III Sampling and Analysis Plan, provided in Appendix F.

2.4 Geology/Hydrogeology

The Tujunga Well Field is located in the northeastern part of the San Fernando Valley, which is both a structural and geographic basin. The basin is bound to the north by the San Gabriel Mountains and the bounding structures of the Sylmar Basin, including the Sylmar Fault. The basin is bound to the east by the San Gabriel and Verdugo mountains (the latter bound by the Verdugo Fault Zone, or VFZ), to the south by the Santa Monica Mountains, and to the west by the Simi Hills. The basin is filled by Tertiary and Quaternary sediments that coarsen on the eastern side of the basin, where they are proximal to the sedimentary provenance, primarily shed from the San Gabriel Mountains.

Water-bearing units are generally restricted to the unconsolidated sediments in the upper 200 to 1,000 feet of the basin in this area. Unconsolidated sediments consist of Quaternary gravels and sands of the Monterey Formation, as well as gravels, sands, silts, and minor clays of Upper Tertiary units. Groundwater generally flows from the Northwest to the Southeast in the unrestricted part of the basin, and flows from the Northeast to the Southwest in the area around the Hanson Reservoir/Tujunga Canyon area (Figure 1-1). The aquifer is unconfined and vertically continuous through the water-bearing units (ULARA, 1981).

The VFZ bisects the study area into North and South Operational Areas. The fault zone is primarily reverse in nature, with the north block uplifting with respect to the south block. The VFZ is also parallel to a number of regionally significant strike-slip faults (i.e. the San Andreas, Whittier, and Newport-Inglewood faults, for example), and therefore may have a strike-slip component as well. The vertical displacement across the VFZ is at least 4,000 feet, and several splays displace, and potentially isolate, smaller slivers of geologic materials along the fault zone. The VFZ has no surface expression and is inferred to be buried by several tens, to over a hundred feet of Quaternary sediments. The VFZ may also be incised by paleo-wash deposits of the Tujunga and Pacoima drainage systems (ULARA, 1981; DWP, 2008).

Groundwater elevations north of the VFZ are generally 75 to 200 feet below ground surface (bgs), and 350 to possibly 400 feet bgs south of the VFZ. Groundwater appears to flow across the fault (Contact Report #1). The fault is mapped by the Upper Los Angeles River Authority (ULARA) as a "cascade structure," where groundwater flows across the fault uninhibited, and drops precipitously with the increased depth of the basin on the south side of the fault zone. Limited data suggest that groundwater flow across the fault may be more complicated, but groundwater clearly communicates across the fault (California Water Resources, 2004; DWP, 2008; ULARA, 1981).

Geologic logs from the Tujunga Well Field were provided by the DWP. These logs provide a first-order picture of the water-bearing geology in the Study Area. The lithologies include highly conductive gravels, sands, boulders, and sandy gravels, with only minor silt-bearing units of lower conductivity. This is consistent with wash deposits in a transitional alluvial fan/alluvial plain environment.

Two geologic cross sections through the Study Area are provided in Figures 2-4 and 2-5 and are based on data gathered from production and monitoring well logs. The E-W cross section includes data from the Tujunga Wellfield, as well as the EV- wells. The lithologies represent coarse-grained materials (sands, gravels, and boulders) of the Tujunga Wash as it cut through finer sediments (primarily silts and silty sands, with minor clays).

Groundwater elevation data are from the 2008 LADWP sampling event. The elevations for the Tujunga Wellfield production wells are inferred, as these data have not been provided by LADWP. The elevations are normalized to Mean Sea Level with respect to the casing height; elevations, where not provided in the geologic logs, are interpolated from GoogleEarth Pro (GoogleEarth, 2010). The groundwater gradient in this cross section is generally east to west. Variations in groundwater elevations between wells can be used to infer subsurface structures, such as faults and other potential hydraulic barriers. The groundwater gradients between EV-01 and EV-02, and EV-04 and EV-02, appear to be greater than the overall gradient of the cross section, which is consistent with the location of the VFZ. The cross section indicates that EVs - 01 and -04 are on the up-thrown side of the fault.

The N-S cross section (Figure 2-5) Includes data from LADWP monitoring wells, the Tujunga Wellfield, and groundwater monitoring wells from the Price Pfister facility (EKI, 2008). The geology includes interbedded coarse-grained materials and finer grained, silty materials. There is also the appearance of what is logged as, "granodiorite basement complex," at approximately 300 feet bgs at PA-02A. This is unusual for a location south of the inferred location of the VFZ.

Water level data are from the LADWP 2008 sampling event, as well as EKI, 2008, and Arcadis, 2008. The water level data indicate a gradual gradient from the north to the south. Significant variations in the gradient are observed between PMW-40 and PA-01, and PA-01 and PA-02A. Weston infers faulting between these areas. ULARA (1984), Arcadis (2008), and EKI (2008) place the VFZ between PMW-40 and PA-01. Maps produced by Arcadis (2008) that incorporate data from a dense cluster of monitoring wells also indicate a fairly complex structure of the aquifer in the area of the Holchem/Price Pfister area.

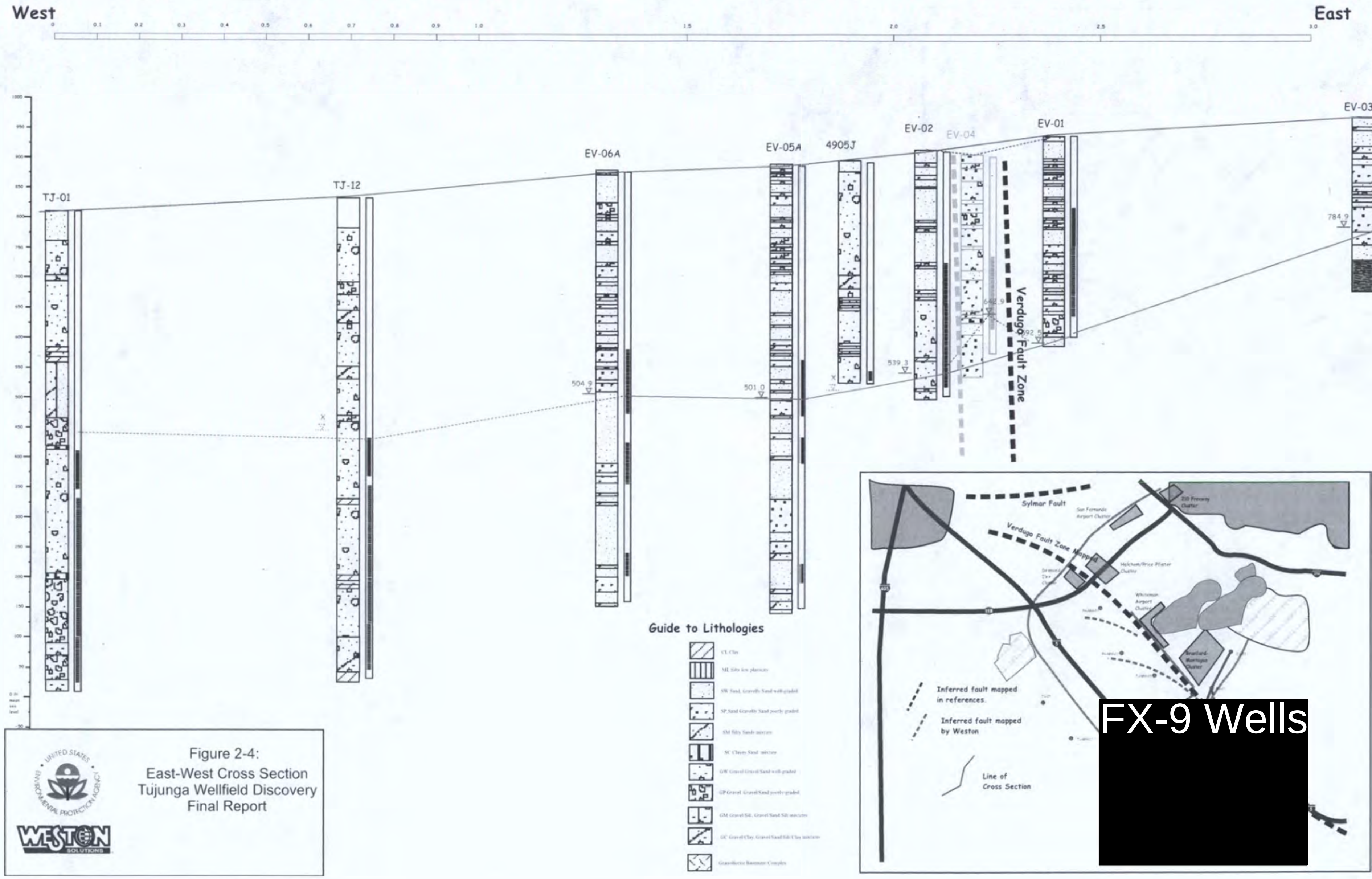


Figure 2-4:
East-West Cross Section
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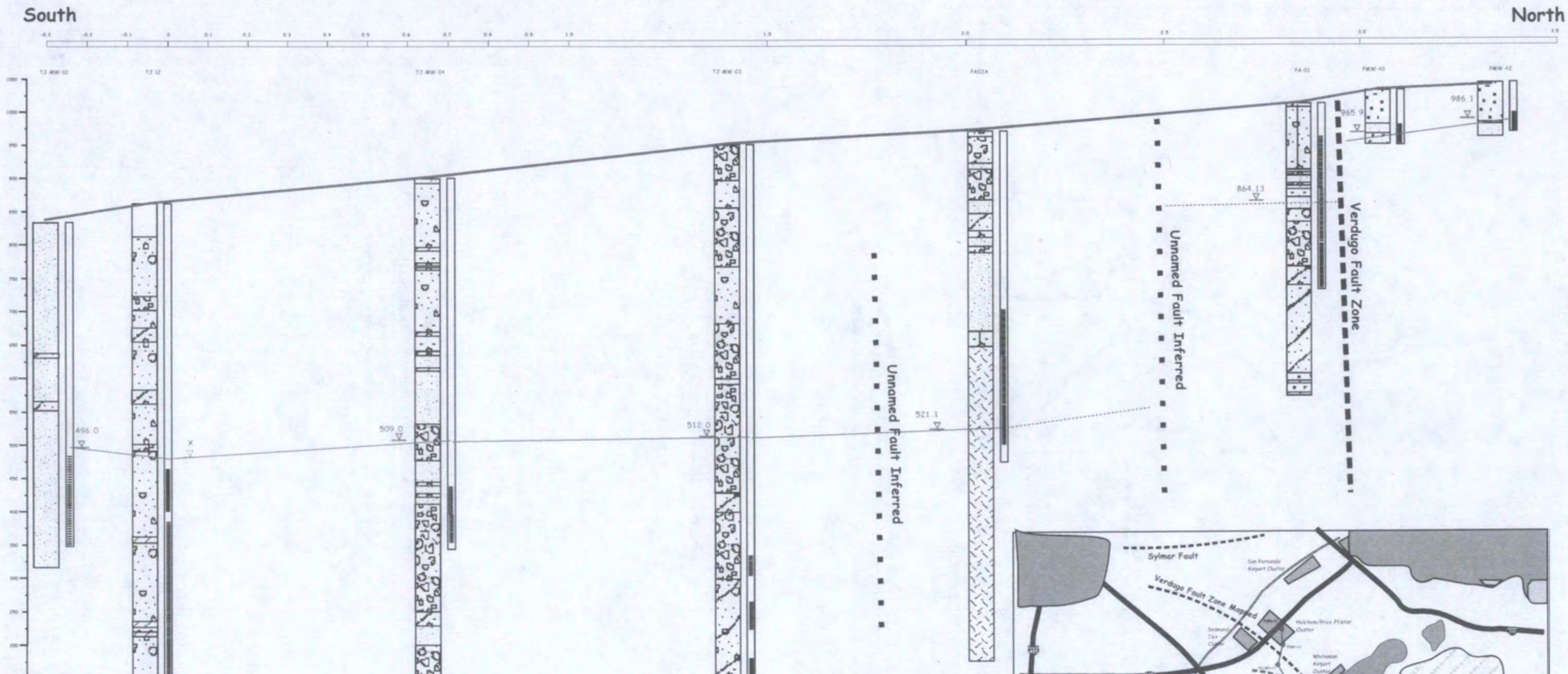


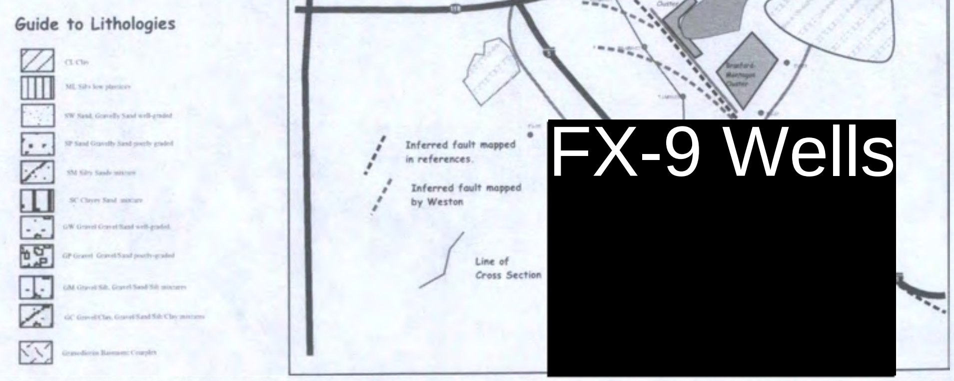


Figure 2-5:
North-South Cross Section
Tujunga Wellfield Discovery
Final Report

The granodiorite logged in PA-02A corresponds to granodiorite mapped in the Whiteman Hills, above the Whiteman Airport. The presence of this lithology and its relationship to the outcropping units suggests that PA-02A may be on the up-thrown side of the VFZ, or may represent an uplifted sliver of material along the fault zone. The gradient observed in the well is consistent with the other wells to the south, and indicates that any fault that exists south of this well does not behave as an aquitard.

2.5 Waste Characteristics

Site records indicate the presence of TCE and PCE in groundwater pumped from the Tujunga Well Field at concentrations exceeding MCLs during several sampling events. The highest historical concentrations of TCE range from 4.86 to 46.4 ppb across the wellfield. The highest historical concentrations of PCE range from 1.91 to 27.9 ppb across the wellfield. The MCLs for TCE and PCE are both 5 micrograms per liter (ug/L). In addition, carbon tetrachloride, hexavalent chromium, perchlorate, nitrates and total chromium have also been regularly detected in several wells (LADWP, 2008; CH2M Hill, 2009).

An analysis of the concentrations of chlorinated VOCs in the well field indicates consistently higher concentrations of PCE and TCE in Tujunga Wells TJ-04 through TJ-09 (Figure 3). Carbon Tetrachloride has only been detected in TJ-05 through TJ-09; 1,2 Dichloroethene-cis has only been detected in wells TJ-05 through TJ-09. These wells are directly down-gradient and adjacent to the BSB, and the concentration curve for each of these contaminants is centered about the BSB.

3.0 TUJUNGA FIELD EFFORTS

WESTON conducted two field efforts in support of the Tujunga Discovery Project. Stage I, which was performed from January to April of 2009, consisted of transect and site sampling for soil and soil vapor in the source area of the Tujunga Wellfield. Stage II, which took place from December 2009 to March 2010, consisted of refurbishing and sampling two LADWP monitoring wells, and conducting sediment core sampling in the Branford Spreading Basin.

The details of this investigation are provided in the Stage I & II Tujunga Wellfield Discovery final reports, which are included as Appendix A of this document. Summaries of activites and results are provided below.

3.1 Stage I

3.1.1 Stage I Field Effort

The Stage I workplan called for the installation and sampling of soil vapor probes along five transects and at six industrial sites in the Tujunga Wellfield Discovery Study Area. Overall, WESTON attempted 250 soil borings and installed 200 soil vapor probes in support of Stage I activities. Soil vapor probe installation was hampered by boring refusal due to uncooperative geologic materials. All soil vapor probes were sampled and abandoned without incident.

The results of the Stage I soil vapor sampling are summarized in Figure 3-1. The details, including both soil vapor and soil results, are presented in the Stage 1 Final Report (Appendix B).

3.1.1.1 Transect Sampling

WESTON conducted 180 borings and installed 149 soil vapor probes along the five transects in the study area. Transect soil vapor probes were installed from 8 to 20 feet below ground surface, based on feasibility of penetration. WESTON encountered a high rate of refusal (~10%) in the transects due to bouldery strata, especially in the areas farthest north and east.

The transect soil vapor results indicate four areas of concern along the transects where PCE, and to a lesser degree, TCE are detected. It is not clear whether these soil vapor detections are a result of groundwater offgassing or ambient soil vapor from a local source. The PCE:TCE ratio is not consistent with a source for the Tujunga Wellfield contamination; however, it is unclear whether vadose zone contaminant fractionation might be occurring.

3.1.1.2 Site-Specific Sampling

WESTON conducted 31 borings and installed 56 soil vapor probes at six facilities in the study area, as well near a cluster of facilities in the vicinity of Desmond Street and Ilex Avenue. Transect soil vapor probes were installed at 5 and 15 feet below ground surface at each on-site location, at at 15 feet bgs in the Desmond-Ilex area. WESTON also collected soil samples at facilities for metals analysis for comparison with a background suite collected from the transects.

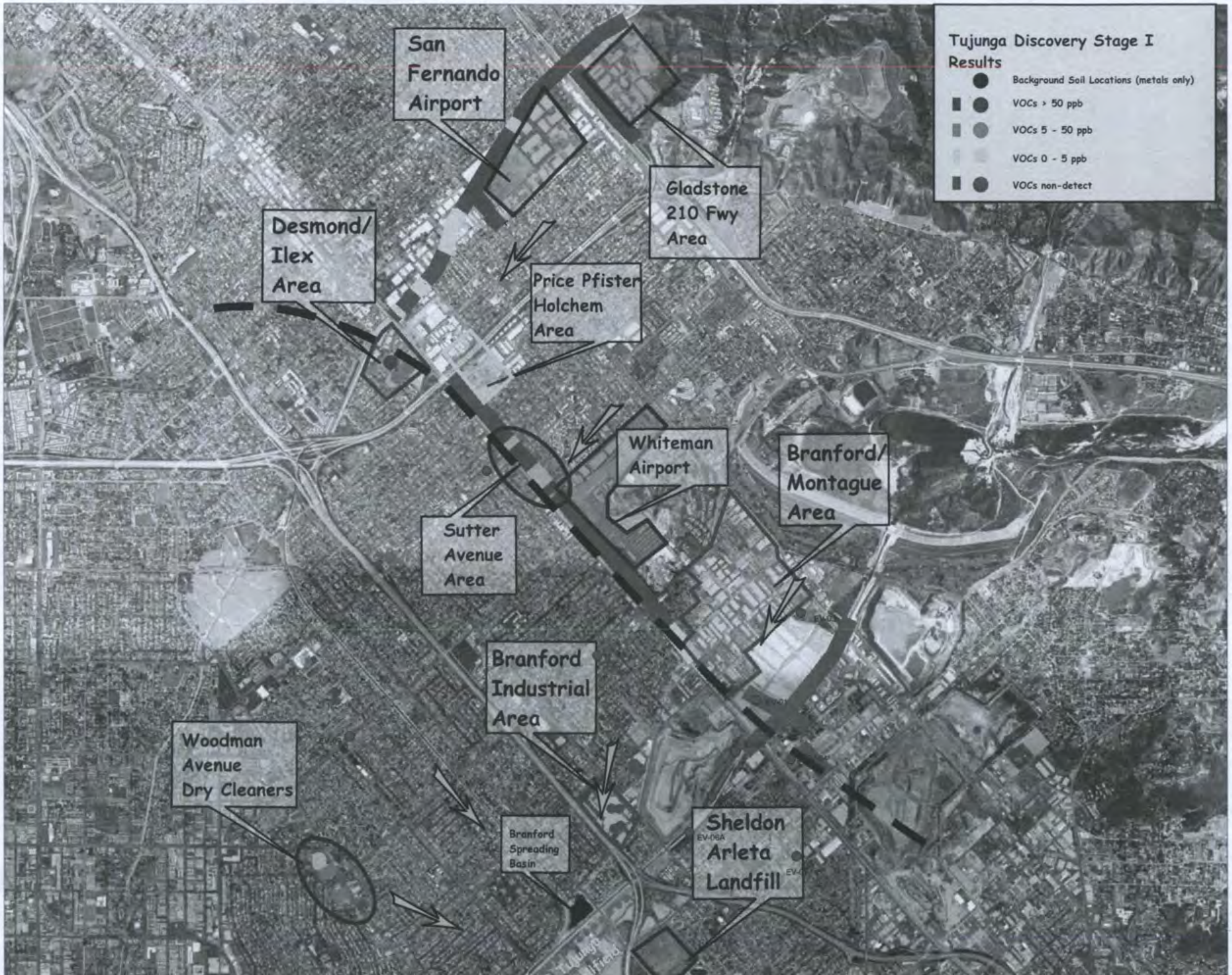


			Figure
Areas of Primary Interest Areas of Secondary Interest Verdugo Fault Zone	Tujunga Well Field Site Discovery Stage II Report	Soil Vapor Results	Figure 3-1

The site-specific soil vapor results indicate low levels of PCE at five of the six sites investigated. TCE was also identified at the two sites in the Branford Industrial Park (Miles Chemical and Superior Thread Rolling). The concentrations of PCE and TCE measured are not high enough to indicate a source at these sites capable of producing the observed contamination in the Tujunga Wellfield.

Relatively high concentrations of PCE and TCE (up to 100 and 7.3 ppb, respectively) were detected in the Desmond-Ilex area. The locations of these soil vapor probes were in the city streets, adjacent to suspect facilities. The concentrations observed at these proximal locations strongly indicate a chlorinated solvent issue in this area that should be investigated further.

3.2 Stage II

3.2.1 Monitoring Well Sampling

WESTON assisted the Tujunga Field Team with repairs and groundwater sampling at two LADWP-owned monitoring wells in the Tujunga Wellfield capture zone.

Work at TJ-MW-01 (see Section 2.3.3) was conducted in December 2009 with the refurbishing of the conductive casing and replacement of the dedicated pump. The Field Team conducted stratified groundwater sampling using a 10-foot long packer assembly. Seven discrete-depth groundwater samples were collected and analyzed for Title 22 contaminants (including chlorinated VOCs) by a DTSC laboratory.

Work at TJ-MW-03 was conducted in January and March of 2010 with the replacement of the dedicated pump and subsequent groundwater sampling. A single grab sample was collected from the pump depth of the well and analyzed for Title 22 contaminants by a DTSC laboratory.

The groundwater analytical results for both TJ-MW-01 and TJ-MW-03 indicate no chlorinated VOCs detected above the 0.5 ug/L detection limit. Data from TJ-MW-01 indicate that the Sheldon-Arleta Landfill is probably not the source of contamination in the Tujunga Wellfield; the data also suggest that contamination is effectively captured by pumping by the active production wells. Data from TJ-MW-03 indicate that contaminants are not likely coming from the area directly upgradient (northeast) of the well, which is the area around the Whiteman Airport.

3.2.2 Branford Spreading Basin Sediment Sampling

WESTON conducted seventeen cores through the sediments of the Branford Spreading Basin during two field events, which occurred in January and April of 2010. The first seven cores, done with a Vibro-Core device, did not penetrate the sediment pile. All of the remaining cores, conducted using auger and direct-push methods, penetrated the full depth of the sediments.

Chlorinated VOCs were tentatively detected in sediments from one boring location; however, due to the presence of high concentrations of acetone and MEK in most of the sediments, the much lower concentrations of chlorinated compounds were qualified as "unusable" during the validation process.

Metals results indicate that the sediments are enriched in metals, especially lead, with respect to their source provenance. Lead and arsenic both exceed three times the background concentrations in the BSB sediments. LADWP has not reported any issues with these compounds in the adjacent well field; it is unlikely that these compounds could effectively migrate to the well field.

These ambiguous results do not clearly demonstrate the presence of a source in the Branford Spreading Basin, but do not rule it out, either. The sediment color and presence of organic material indicate an anaerobic environment in the sediment profile. Such an environment would degrade chlorinated compounds while slowly leaching into the vadose zone below. The ubiquitous presence of acetone and methyl ethyl keytone may also indicate anaerobic degradation of hydrocarbons in the sediments. The high concentrations of these hydrocarbons also created laboratory interferences which made analyzing TCE and PCE at lower concentrations difficult. Determining whether the Branford Spreading Basin is a source may best be done through the installation of monitoring wells in the upgradient aquifer.

4.0 STAGE III: GROUNDWATER MONITORING WELLS

The Stage III Scope of Work involves installing monitoring wells upgradient of the Tujunga Well Field. The wells will be installed consecutively, starting with a deep, Pilot Well. Subsequent wells will be installed in a triangulating, step-out configuration in an attempt to define the shape of the groundwater contamination plume.

The stakeholder agencies in the Tujunga Discovery Team have individual goals for the monitoring well installations, as well as the mutual goal of identifying the plume (and eventually the source) of the contamination in the Tujunga Wellfield. The Tujunga Discovery Team seeks to optimize the groundwater monitoring well program to meet multiple objectives wherever possible.

The EPA seeks to collect data which will lead to the identification of potential National Priorities List (NPL) sites through the HRS process. This requires the strategic placement of groundwater monitoring wells in such a manner that identifies the groundwater plume and provides data that allow for backtracking to the source(s) of the plume. The ultimate goal of the EPA is to remediate the source of the contamination through the Superfund Remedial Program, should the site, or sites, associated with this Discovery be listed on the NPL.

One goal of the LADWP is to install wells that provide characterization data for the Tujunga Wellfield capture area, as well as provide sentinel data for incoming contamination to the wellfield for at least a ten-year lag time. This goal supports the LADWP 's long-term objective to install a Wellhead Purification Complex to address water quality issues in the SFV (see Section 2.4). According to the CDPH (1997) Memo (aka. "97-005 Memo"), an evaluation of the aquifer source area is required as part of the permitting of the Wellhead Purification Complex, including the installation of groundwater monitoring wells for the characterization of the aquifer.

4.1 Synthesis of Current Groundwater Data

Recent groundwater data in the Tujunga Wellfield capture zone can be derived from two sources: 1) the array of LADWP-owned monitoring wells (see Section 2.4), and 2) site-specific wells installed at the Price-Pfister and Holchem facilities (see Section 2.3).

4.1.1 LADWP Monitoring Wells

As indicated in Section 2.4 above, one of the first goals of Stage I of this investigation was to identify all operational monitoring wells in the Tujunga Wellfield capture zone and conduct a sampling event to provide a recent snapshot of groundwater conditions in the study area.

A review of well records indicated that LADWP owned approximately 30 wells in the study area (EPA, 2008). LADWP provided information in 2008 stating that many of these wells were either dry due to falling groundwater levels or destroyed, and that only seventeen wells were potentially screened in the aquifer. Of these seventeen wells, LADWP was only able to sample eight wells. Of the wells not sampled, two wells were not sampled because they are co-located with newer wells that are more optimally screened, two wells were not sampled because of construction at the Hansen Spreading Basin, and five wells were not sampled due to problems with the dedicated pump system (LADWP, 2008).

The two most critical of the unsampled wells, TJ-MW-01 and TJ-MW-03, were repaired and sampled during Stage II of this investigation (see Section 3.2.1 and details in Appendix C). The TCE and PCE data from that sampling event are presented in Figure 4-1, along with the data from the 2008 LADWP sampling event and the January 2009 Tujunga Wellfield sampling data.

As identified during the initial phases of this investigation, the concentrations of TCE and PCE in the Tujunga Wellfield range from ND to 35.5 ppb, and ND to 19.4 ppb, respectively, across the wellfield. The concentrations are highest in the four wells in the center of the wellfield; although no data were reported for TJ-10 during that quarter's sampling event (CH2MHill, 2009). TCE to PCE ratios range from 1.8 to 9 in the these wells during this sampling event.

The combined 2008 and 2009 LADWP monitoring well data, with the exception of EV-02, are from wells located south of the VFZ. Of the ten wells sampled, only PA-MW-01 and TJ-MW-04 (aka EV-08) have detected TCE and/or PCE. The concentrations of TCE and PCE are one to two orders of magnitude lower than those observed in the Tujunga Wellfield, and the ratios of TCE/PCE from the two monitoring wells are less than 1.0. The lower TCE/PCE ratios in the monitoring wells strongly suggests that these wells are not screened in the fringes of the plume responsible for the contamination in the Tujunga Wellfield.

4.1.1 Groundwater at the Holchem Facility

As stated in Section 2.3.2, the DTSC is the lead agency at the Holchem (former Chase Chemical Company) site, which is located at 13540 and 13546 Desmond Street, Pacoima, California, approximately three miles to the north-northwest from the Tujunga Wellfield. As of the third quarter in 2008, approximately 23 groundwater monitoring wells have been installed at, or downgradient of the site. All but six of these wells are on the northeast (upthrown-side) of the VFZ. Groundwater flow from the Holchem site is generally to the south-southwest, flowing across Highway 118, toward both the VFZ and the former Price Pfister site.

The six Holchem wells installed southwest of the VFZ include two co-located wells at three locations. The co-located wells are screened at different depths, and the two northernmost locations exhibit groundwater elevation differences ranging from 60 to 100 feet between the co-located wells. The two wells at the southernmost location have the same groundwater elevations, suggesting that water-bearing units in which these wells are screened are hydraulically connected (Arcadis, 2008).

The Groundwater elevations in the six Holchem wells on the southwest side of the VFZ, along with LADWP's PA-01, indicate a complicated aquifer structure. Groundwater appears to flow roughly to the north, from the southern well locations, and to the south from the northernmost well location, toward Filmore Street (Arcadis, 2008). This may be a localized artifact of channels cut by paleostream activity across the VFZ and through this area, or complex splaying of the VFZ.

Figure 4-1: Groundwater Monitoring Well Data Tujunga Discovery Project Stage III

Groundwater monitoring at the Holchem wells indicates the presence of TCE and PCE at concentrations up to 75 and 50 ppb, respectively, in groundwater underneath the site. PCE is detected in an upgradient groundwater monitoring well at 2.5 ppb; TCE is not detected in this upgradient well. The wells downgradient of the Holchem site show TCE and PCE detected as far south as the southernmost well on the southwest side of the VFZ, on Pinney Street. Only PCE is detected in the two northern, co-located well sets on the southwest side of the VFZ, but both TCE and PCE are detected in LADWP's PA-01 well. The Holchem facility has an active soil vapor extraction system at the site, as well as quarterly groundwater monitoring (Arcadis, 2008).

4.1.2 Groundwater at the Former Price Pfister Facility

As stated in Section 2.3.2 above, the LARWQCB is the lead regulatory agency at the former Price Pfister facility, located at 13500 Paxton Street, Pacoima, California. This site is on the opposite side of Highway 118, and directly downgradient, from the Holchem site. The site has since been redeveloped into retail shopping.

Investigative activities at the site include the installation of 48 monitoring wells, as well as numerous soil borings and groundwater grab samples. Both TCE and PCE were identified in soils and groundwater beneath the site, with primary sources in the vapor degreasing area and oil storage area. Hexavalent chromium has also been identified in soils and groundwater at the site. Remedial activities at the site include the excavation and removal of over 20,000 cubic yards of VOC- and/or chromium-contaminated soils, as well as the installation of soil vapor extraction systems to address VOCs in the vadose zone, and in situ air sparging systems to address groundwater contamination at the site (EKI, 2010).

Groundwater flow underneath the former Price Pfister site is generally to the south-southwest, with a precipitous 40- to 50-foot drop in groundwater elevation in the southern half of the site. The groundwater gradient south of this drop is almost due west. This drop is interpreted by both Arcadis (2008) and EKI (2010) as being related to faulting; however, Alice Campbell of the DTSC believes that the drop is the result of preferential dewatering along a paleo-wash that has penetrated the VFZ in this area (A. Campbell, personal communication, ad nauseum, 2008 – 2010).

Groundwater monitoring at the site indicates the presence of TCE and PCE at concentrations up to 90 and 77 ppb, respectively. Both PCE and TCE are detected in upgradient groundwater monitoring wells associated with the Holchem facility (EKI, 2007; EKI, 2010). Concentrations of TCE and PCE in the downgradient wells appear to define the combined Holchem/Price Pfister plumes down to about 1 to 2 ppb (EKI 2010; Arcadis, 2008); however, there do not appear to be enough data south of the VFZ to verify this statement.

4.2 Data Gaps in the Groundwater Database

The groundwater monitoring coverage of the Tujunga Wellfield study area is sparse in most areas. There are few site investigations, and the LADWP's current well array includes approximately 10 functional monitoring wells covering about 28 square miles of aquifer. None of these groundwater monitoring wells yields contaminant concentrations that indicate a groundwater plume capable of generating the consistent TCE and PCE concentrations observed at the Tujunga Wellfield.

There are almost no groundwater monitoring wells in the near vicinity of the Tujunga Wellfield. The closest upgradient groundwater monitoring well is EV-06B, which is located approximately ¾ mile from the Tujunga Wellfield. The next closest groundwater monitoring well is TJ-MW-04 (EV-08), which is located about one mile from the wellfield. The remaining, upgradient groundwater monitoring wells are even farther away, and farther spread out from the wellfield.

As shown in Figure 4-1, the area to the southwest of the VFZ contains the largest area of data gap. There are almost no wells in this area, and there is plenty of space for a Hochem/Price Pfister-sized plume to hide. There are also few potential sources in this area, with the exception of a cluster of industrial sites along the Pacoima Wash, the Desmond-Ilex Area, the Branford-Laurel Canyon Area, and the strip along San Fernando Road.

The area to the northeast of the VFZ also has several areas for which no groundwater data are available, and there are several large areas of industrial activity for potential sources. There are few wells near the Branford-Montague Area, as well as to the north of the Holchem/Price Pfister sites.

The VFZ is poorly understood in the study area. The fault is mapped as a thrust by several authors (ULARA, 1981, Dibblee 1981, Arcadis 2008, EKI, 2010); however, seismic and gravity studies indicate that the fault dips to the southwest along its southern end (south of the study area), indicating normal movement in that area (USGS, 2000). Most authors place the fault along San Fernando Road in the study area (ULARA, 1981, Arcadis 2008, EKI, 2010); at least one source maps the fault along Glen Oaks Blvd (Dibblee, 1981).

There are at least two locations in the study area where groundwater wells appear to penetrate both sides of the fault. The first is along the Tujunga Wash, between EV-04 and EV-02, where there is a 100-foot drop in groundwater elevation over a quarter mile distance. The second area is in the Holchem/Price Pfister area, where the drop is about 60 to 100 feet. In both cases, groundwater deepens further to the southwest of the fault.

The second area has a more complete coverage of monitoring wells on both sides of the fault, and the resulting groundwater picture is extremely complicated. To the northeast of the VFZ, groundwater abruptly drops 40 to 60 feet along a trend that is nearly perpendicular to the VFZ, and groundwater flows almost due west toward the fault beneath that feature. To the southwest of the VFZ, groundwater appears to flow in opposing directions, which has been interpreted as semi-isolated fault blocks (Arcadis, 2008). The VFZ is also interpreted to bend to the west in the northern part of the study area, meeting up, or running parallel to, the Mission Hills Fault (ULARA, 1981). Contaminants are detected on either side of the VFZ, so there is strong evidence that it is not an aquiclude, but the nature of the fault needs to be better understood.

5.0 PROPOSED NEW GROUNDWATER MONITORING WELLS

New monitoring wells in the Tujunga Wellfield study area are needed to fulfill several data needs. The regulatory agencies (EPA and DTSC) need to delineate the plume to follow it back to the source or sources. The LADWP needs not only to delineate the plume, but characterize the source aquifer for the Tujunga Wellfield in order to comply with the permit process for its Wellhead Purification Program.

5.1 Groundwater Contamination Delineation

In order to identify the groundwater contamination plume that is intersecting the Tujunga Wellfield, groundwater monitoring wells should be installed directly upgradient from the wellfield. The first wells should be installed within ¼ to ½ mile from the wellfield, directly upgradient from the most highly affected production wells. The most optimum area for installing this well or batch of wells would be along Wentworth Street, between Woodale and Stanwin avenues.

Subsequent wells should be installed at locations that are based on the analytical results of the first well or wells. Should the initial well or wells intersect the contaminant plume, then additional wells may be installed upgradient of the initial well to triangulate the area of highest concentration and the direction from which the plume is trending. Should the initial well or wells not intersect the contaminant plume, then new wells should be installed along the same parallel trend to the Tujunga Wellfield as the initial well or wells until the plume is intersected. The study team should be able to identifying intersecting the plume by detecting TCE and PCE at concentrations and proportions consistent with those observed in the Tujunga Wellfield. The spacing of these wells should be approximately 600 feet apart (twice the distance of the Tujunga Wells from each other), and then the next batch of wells could be installed to fill in the array spacing to 300 feet if the plume is not found.

In the event that groundwater wells do not identify the plume, then the study team should re-evaluate the possibility of the source being the Branford Spreading Basin (BSB). There is a strong correlation between the observed highest concentrations of AOCs along the margins of the BSB. The historical watershed for the BSB includes many of the industrial source areas suspected or known to have used TCE and PCE. Because of the interference with higher concentrations of acetone and MEK, a soil vapor study of the vadose zone beneath the BSB and/or between the BSB and the Tujunga Wellfield may be the best approach.

5.2 Aquifer Characterization

One goal of the LADWP is to install wells that provide characterization data for the Tujunga Wellfield capture area, as well as provide sentinel data for incoming contamination to the wellfield for at least a ten-year lag time. This goal supports the LADWP 's long-term objective to install a Wellhead Purification Complex to address water quality issues in the SFV. According to the policy of the State of California Department of Health Services (CDHS, now the Department of Public Health), Policy Memorandum 97-005, an Evaluation Process for the use of Extremely Impaired Sources (contaminated groundwater) is required as part of the permitting of the Wellhead Purification Complex, including the installation of groundwater monitoring wells for the characterization of the aquifer.

The LADWP is in the process of completing a workplan identifying the locations and construction parameters of these wells. The wells will be installed in the ten-year capture zone of the aquifer. LADWP has not determined the final number or distribution of sentinel wells.

5.3 Monitoring Well Construction Parameters

The LADWP has provided monitoring well construction parameters for three generic scenarios where wells are installed with one to three zone completions. The full scope of work, including estimated depths and locations, has not been completed by LADWP as of the date of this report. Schematics for the scenarios are presented in Figures 5-1 through 5-3.

The scenarios are:

Three-Zone Nested Completion Monitoring Wells

- Pilot boring to td = 690 feet.
- Simulprobe sampling every 50 feet in the saturated zone.
- Reamed borehole of 16 inch to 18 inch diameter (or other recommended diameter).
- 4-inch Sch 80 PVC casing (screened from 650 to 690 ft bgs).
- 4-inch Sch 80 PVC casing (screened from 450 to 490 ft bgs).
- 4-inch Sch 80 PVC casing (screened from 300 to 380 ft bgs).
- Two 1-inch Sch 80 PVC casings suspended within the shallow 4-inch casing.
- Above casings equipped with ZIST sampling equipment (four units total).
- Three 1-inch PVC piezometers screened at 380 ft, 490 ft, and 690 ft.
- Transducers and data loggers furnished and installed within each piezometer.

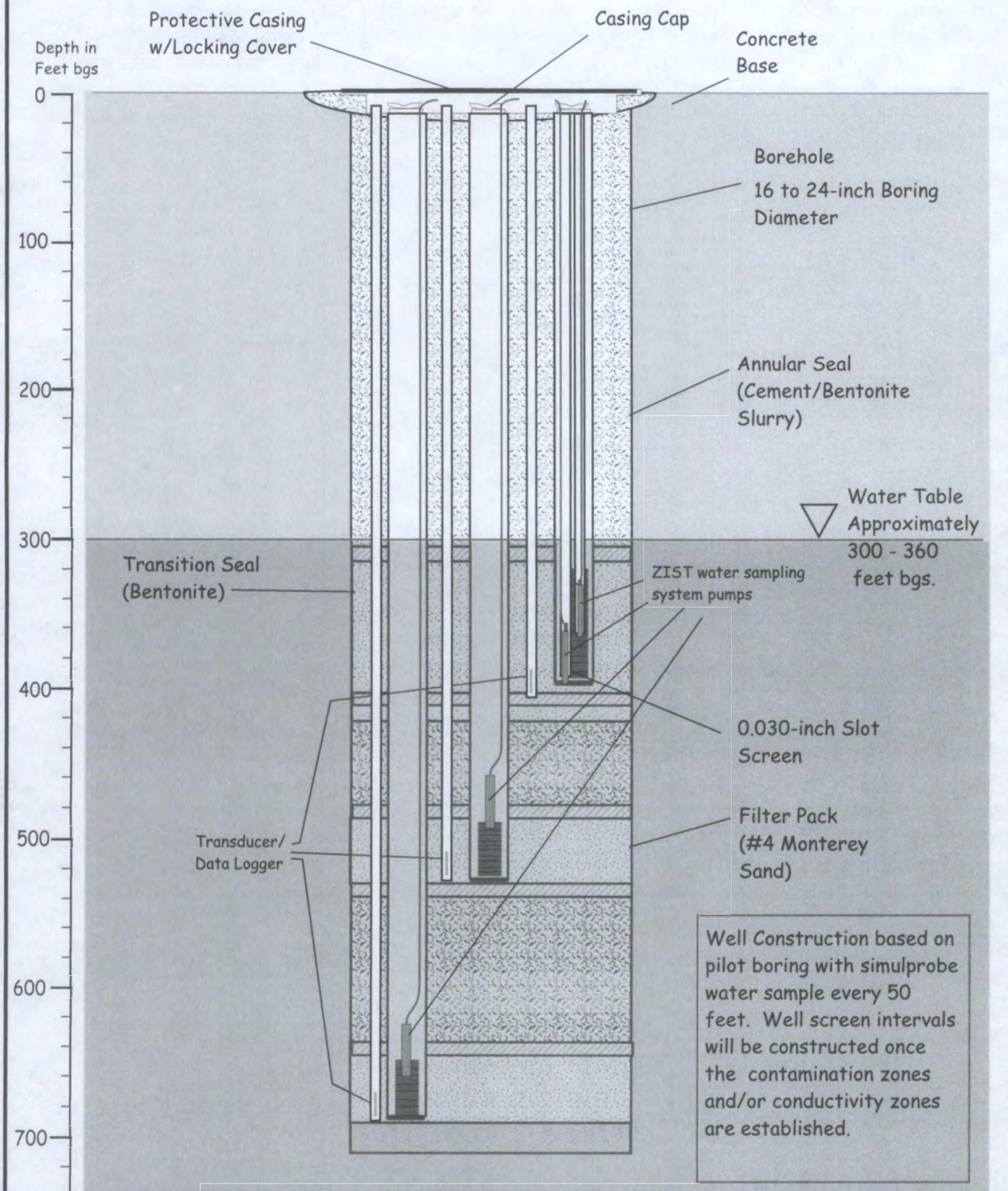
Two-Zone Nested Completion Monitoring Wells

- Pilot boring to td = 690 feet.
- Simulprobe sampling every 50 feet in the saturated zone.
- Reamed borehole of 12 inch to 14 inch diameter (or other recommended diameter).
- 4-inch Sch 80 PVC casing (screened from 650 to 690 ft bgs.).
- 4-inch Sch 80 PVC casing (screened from 450 to 490 ft bgs).
- Above casings equipped with ZIST sampling equipment (two units total).
- Two 1-inch PVC piezometers screened at 690 ft and 490 ft.
- Transducers and data loggers furnished and installed within each piezometer.

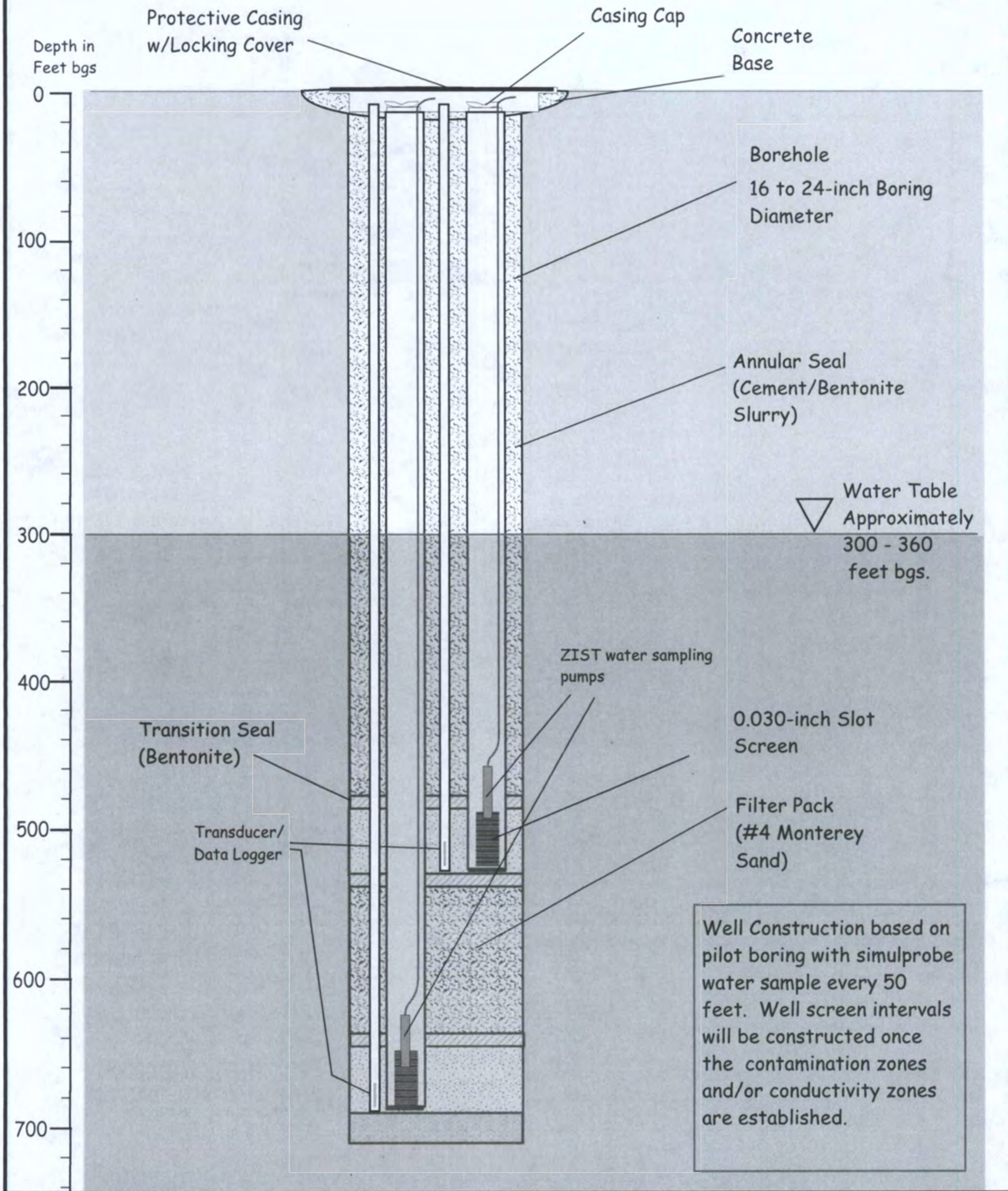
Single-Zone Completion Monitoring Wells

- Pilot boring to td = 690 feet.
- Simulprobe sampling every 50 feet in the saturated zone.
- Reamed borehole of 10 inch to 12 inch diameter (or other recommended diam).
- 4-inch Sch 80 PVC casing (screened from 300 to 380 ft bgs).
- Two 1-inch Sch 80 PVC casings suspended within the 4-inch casing.
- Each 1-inch casing equipped with ZIST sampling equipment (two units total).
- 1-inch PVC piezometer screened at 380 ft.
- Transducers and data loggers furnished and installed within each piezometer.

In each case, a pilot well is drilled to the total aquifer depth (690 feet for the generic scenario). Groundwater is sampled every 50 feet through the water-bearing zone using Simulprobe technology. Once the pilot boring is completed, then a geophysical log is conducted in the borehole to determine the zones of highest conductivity. These data, along with the groundwater grab samples and the geologist's logs, will be used to determine the zone, or zones, in which wells will be constructed.



WESTON SOLUTIONS Restoring Resource Efficiency Weston Solutions, Inc. 9301 Oakdale Ave, Suite 320 Chatsworth, CA 91311 818 464-7050	Tujunga Discovery Stage III Final Report	3-Zone Well Construction Schematic	Figure 5-1



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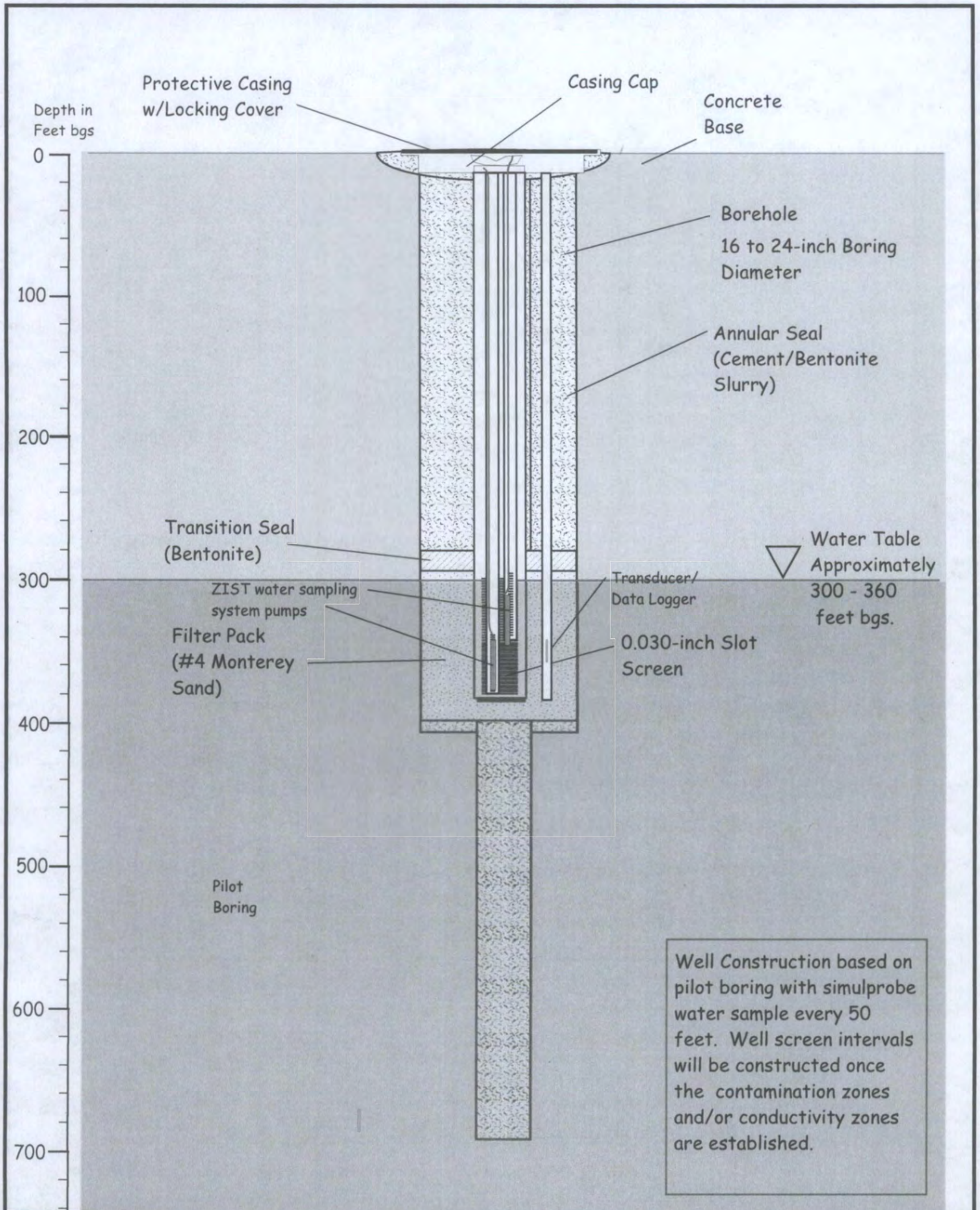
Weston Solutions, Inc.
9301 Oakdale Ave, Suite 320
Chatsworth, CA 91311
818 464-7050

Tujunga Discovery
Stage III
Final Report

2-Zone Well
Construction
Schematic

Figure
5-2



WESTON SOLUTIONS Restoring Resource Efficiency Weston Solutions, Inc. 9301 Oakdale Ave, Suite 320 Chatsworth, CA 91311 818 464-7050	Tujunga Discovery Stage III Final Report	1-Zone Well Construction Schematic	Figure 5-3

6.0 REFERENCES

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APPENDIX A:

Historical TCE and PCE Data for the Tujunga Wellfield

Extracted from the San Fernando Valley Superfund Database, CH2MHill, 2009

APPENDIX B:

Tujunga Discovery Stage I Report

APPENDIX C:

Tujunga Discovery Stage II Report

APPENDIX D:

Tujunga Discovery PA Reports:

- **Miles Chemical Company**
- **Superior Thread Rolling**
- **California Chemical Company**
- **Century West Cleaners**
- **Fulton Cleaners**
- **Swiss Cleaners**
- **Burbank Plating Services**
- **Industrial Metal Plating**
- **PB Fiberglass**
- **California Technical Plating**

APPENDIX E:

DTSC Tujunga Site Discovery Report

APPENDIX F:

Tujunga Discovery Stage III Sampling and Analysis Plan